Risk Adjusted Performance Measures

Asset Allocation / Risk Management

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Investment Committee Meeting

CalPERS

Topics

- Define Performance Measures
- Example Calculations
- Summary

Risk Adjusted Performance Measures

- Question:
  - How do we know if we are generating adequate returns for risk taken?
- Answer:
  - Use risk adjusted performance measures to relate returns and risk.
- Simply stated:
  - How much risk was taken to generate a given level of returns?

Risk Adjusted Performance Measures

We can use these measures:

- Sharpe Ratio
- Sortino Ratio
- Treynor Ratio
- Information Ratio

- Value at Risk (VaR)
- Performance at Risk (PAR)

Sharpe Ratio

$$\frac{Rp - Rf}{\sigma p}$$

Measures portfolio excess return relative to total portfolio risk

- Hedge Fund Partners 0.48
- CalPERS Hedge Fund-UBS 1.32

R_p = Portfolio Return
R_f = Risk Free Rate
σ_p = Standard Deviation of Portfolio Return

Sortino Ratio

$$\frac{Rp - Rf}{\sigma p(down)}$$

Measures portfolio excess return relative to total portfolio risk (negative returns only)

- Hedge Fund Partners 0.77
- CalPERS Hedge Fund-UBS 2.34

R_p = Portfolio Return
R_f = Risk Free Rate
σ_p = Standard Deviation of Portfolio Negative Return

Treynor Ratio

$$\frac{Rp - Rf}{\beta p}$$

Measures portfolio excess return relative to portfolio beta (common factor) risk only

- Arrowstreet Capital 17.8
- Baillie Gifford Overseas Ltd. 25.0

R_p = Portfolio Return
R_f = Risk Free Rate
B_p = Beta of the Portfolio

Information Ratio

$$\frac{Rp - Rb}{\sigma(Rp - Rb)}$$

Measures portfolio active return relative to portfolio active risk (relative to benchmark)

- Enhanced Index 1.57
- Quantitative Management Associates 0.42

R_p = Portfolio Return
R_b = Benchmark Return
$\sigma(R_p - R_b)$ = Standard Deviation of Portfolio Active Return

Value at Risk $ (VaR)

$$\sigma(Rp)*1.645*Vp$$

Measures how much the market value of a portfolio might decrease over a certain time period and at a certain confidence level e.g. “bad case loss”

V_p = Portfolio Value ($)
1.645 = Z-Scale factor for 95% confidence level (assuming returns are normally distributed)
$\sigma(R_p)$ = Standard Deviation of Portfolio Return

Value at Risk (VaR)

	Market Value $ Billions	Total Risk	Value at Risk (VaR) 1 in 20 Year Loss	
			VaR $	VaR %
Total Fund	$208	8.4%	$29	13.8%
PERS 2500 Index Fund	$55	12.3%	$11	20.2%
Internal International Equity Index	$14	14.6%	$3	24.0%

Performance at Risk (PAR)

$$\sigma(Rp - Rb) * 1.645 * (Vp / Vf)$$

Divides VaR$ by Total Fund Value to determine "bad case loss" as % of Total Fund Value

- PERS 2500 Index Fund 7 bp or $14 billion
- Internal International Equity Index 1 bp or $2 billion

V_p = Portfolio Value ($)
V_f = Total Fund Value ($)
1.645 = Z-Scale factor for 95% confidence level (assuming returns are normally distributed)
$\sigma(R_p - R_b)$ = Standard Deviation of Portfolio Active Return

Example

- Assumptions

$R_p = 10\%$

$R_f = 4\%$

$R_b = 9.8\%$

$\sigma_p = 12\%$

$\sigma_{p\ (down)} = 14\%$

$\beta = 1$

$R_p - R_b = .20\%$

$\sigma\ (R_p - R_b) = .40\%$

$V_p = \$1$ billion

$V_f = \$200$ billion

Example

Measure	Calculation	Answer
Sharpe Ratio	(10% - 4%) / 12%	.50
Sortino Ratio	(10% - 4%) / 14%	.43
Treynor Ratio	(10% - 4%) / 1.0	.06
Information Ratio	(10% - 9.8%) / .40%	.50
Value at Risk (Active Risk $)	.40% * 1.645 * $1 billion	$7 million
Value at Risk (Total Risk $)	12% * 1.645 * $1 billion	$197 million
Performance at Risk (Active Risk %)	.40% * 1.645 * $1 billion / $200 billion	.0035%
Performance at Risk (Total Risk %)	12% * 1.645 * $1 billion / $200 billion	.0985%

Summary

Benchmark Independent Measures of Return and Risk Example Application: Absolute Return Strategies	
Sharpe Ratio	Based on total risk – common factor & security specific
Sortino Ratio	Based on total risk – left tail only (non-symmetric)
Treynor Ratio	Based on total risk – common factor only
Relative (Benchmark Based) Measures of Return and Risk	
Information Ratio	Based on active risk Relevant for active strategies measured against benchmark
Measures of How Much We Can Lose	
Value at Risk	Based on either active or total risk
Performance at Risk	Based on either active or total risk as % of Total Fund $